

Conference Abstract

The NFDI4Earth Label as a Tool to Harmonize Earth System Science Data Repositories

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Abstract

Data repositories play a central role in enabling sustainable research data management and long-term accessibility of scientific information. Within the Earth System Science (ESS) domain, a large number of repositories exist, often operated by different institutions and communities. However, their heterogeneous levels of standardization and varying technical maturity present a challenge for cross-repository data integration. Moreover, researchers seeking reliable and sustainable repositories for data deposition require transparent indicators of trustworthiness and interoperability to make informed decisions.

Within *NFDI4Earth* - the German National Research Data Infrastructure for the Earth System Sciences (Bernard et al. 2021) - the NFDI4Earth Label is being developed to address these challenges. The NFDI4Earth Label provides a framework for assessing the FAIRness of research data infrastructures, referring to the principles of *Findability*, *Accessibility*, *Interoperability*, and *Reusability* (Wilkinson et al. 2016). The assessment focuses particularly on technical interoperability and organizational trustworthiness (Grieb et al. 2024).

Its overarching goal is to support the harmonization of data infrastructures by:

- Defining concrete metrics that enable a systematic assessment of interoperability and trustworthiness within an evolving ecosystem of digital ESS services, and

- Providing recommendations to close identified gaps and improve the FAIR alignment of participating repositories.

The framework integrates three complementary assessment components:

1. An automated assessment, which evaluates metadata about repositories already registered in the international [re3data](#) registry of data repositories. This fosters collaboration with an established community resource and ensures up-to-date information on repository standards and interfaces. The extracted information is evaluated against a set of predefined criteria, with particular focus on metadata standards, availability of application programming interfaces (APIs), and the use of persistent identifiers.
2. A self-assessment, in which repository representatives provide information on governance, sustainability, and institutional policies that cannot be automatically retrieved. Repositories already certified with the [CoreTrustSeal](#) (CTS) are recognized as fulfilling this component, reflecting the shared objectives and overlapping standards between CTS and the NFDI4Earth Label.
3. An optional [F-UJI](#)-based evaluation which analyses a subset of datasets at the metadata level, providing additional insights into the FAIRness of data holdings (Huber and Devaraju 2021).

Each component contributes to a defined set of evaluation metrics that address the FAIR principles. To obtain the Label, repositories must meet a minimum threshold; partial fulfillment results in actionable recommendations for improvement. The entire assessment workflow is implemented within the established [OneStop4All](#) service of NFDI4Earth (see Fig. 1), which provides the technical infrastructure for performing and managing evaluations. Repositories that meet the requirements are awarded the NFDI4Earth Label, which is visualized as a digital badge confirming the successful assessment.

In summary, the NFDI4Earth Label provides a practical and community-driven approach to harmonize research data infrastructures, fostering transparency, interoperability, and trust across repositories. While it is currently being developed within the Earth System Sciences domain, the underlying concept and assessment framework are designed to be transferable to other disciplines, supporting broader alignment and integration into international data ecosystems such as the European Open Science Cloud ([EOSC](#)).

Keywords

FAIR, research data management, Earth system sciences, metadata standards, infrastructure harmonization

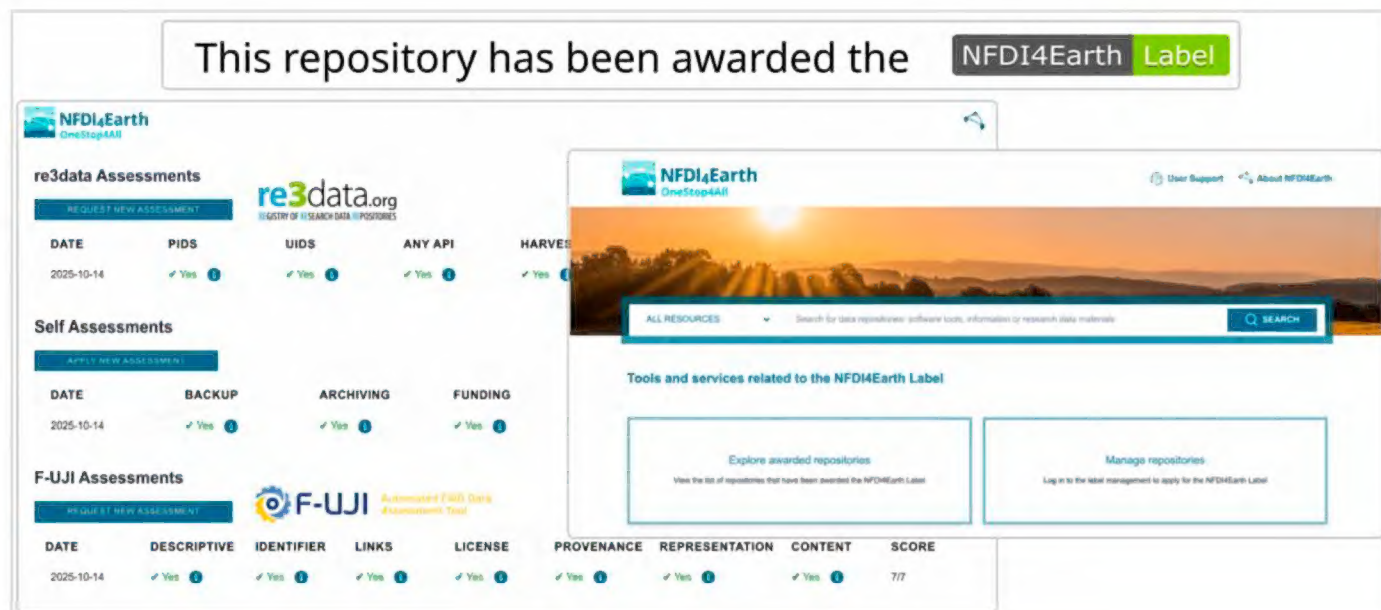


Figure 1.

NFDI4Earth Label assessment framework. The assessment procedure is an integral part of the NFDI4Earth OneStop4All portal, which serves as a central access point to information, tools, and services for research data infrastructures. The workflow consists of a set of intuitive, on-demand tasks that provide immediate feedback on the evaluation results. Repositories that meet the required criteria are awarded the NFDI4Earth Label, which is visualized as a dedicated badge. Pictograms used with reference to their sources (<https://www.re3data.org/>, <https://www.f-ujl.net/>).

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Conflicts of interest

The authors have declared that no competing interests exist.

References

- Bernard L, Braesicke P, Bertelmann R, et al. (2021) NFDI Consortium Earth System Sciences - Proposal 2020 revised. Zenodo <https://doi.org/10.5281/zenodo.5718944>.
- Grieb J, Schäfer T, Frickenhaus S, et al. (2024) NFDI4Earth Label Status Report. Zenodo <https://doi.org/10.5281/zenodo.5718944>.
- Huber R, Devaraju A (2021) F-UJI : An Automated Tool for the Assessment and Improvement of the FAIRness of Research Data. EGU General Assembly <https://doi.org/10.5194/egusphere-egu21-15922>
- Wilkinson M, Dumontier M, Aalbersberg IJ, et al. (2016) The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data 3 <https://doi.org/10.1038/sdata.2016.18>